periodica polytechnica

Transportation Engineering
36/1-2 (2008) 33–39
doi: 10.3311/pp.tr.2008-1-2.07
web: http://www.pp.bme.hu/tr

RESEARCH ARTICLE

Supporting logistics decisions by using cost and performance management tools

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Received 2007-09-03

Abstract

Requirements against logistics services are getting more and more rigorous. Costs and prices have to be decreased significantly, at the same time reliability and quality levels are to be increased continuously. Therefore meeting market demand quickly and efficiently requires sound and effective decision making processes. That is why the managers of logistics service providers as well as the leaders of logistics units in different companies are interested in using dedicated decision support systems making available operational information at appropriate accuracy and data quality levels. Logistics cost and performance management – often referred to as logistics controlling – can help reach these goals by offering well applicable tools for improving management information services. This paper aims at identifying the most appropriate methods of logistics controlling by taking adaptation and implementation issues also into account.

Keywords

logistics · controlling · performance management · cost calculation

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1 Introduction

Cost and performance management in logistics is a coherent set of tools which supports logistics (management) decisions and thus the planning, controlling and monitoring of related business processes. Information produced by accounting as well as technology systems are combined properly so the identification of cause and relationship connections between costs and performances can make efficiency and profitability calculations more exact [1].

There are several methods proposed by the literature to enhance the capabilities of management information systems. The most appropriate from the point of view of logistics controlling are the followings:

1 cost allocation models making use of technological parameters and interrelations;

2 complex multi-criteria evaluation schemes integrating financial as well as technology oriented measures.

The selected methods, however, have been developed mainly for the case of producing (manufacturing) industries so they need to be adapted to the special features of business organisation tasks in logistics.

When building up a logistics controlling system using cost and performance management methods it is essential to consider the role/position of logistics activities in a certain company: some differentiation of applied methodologies is inevitable from this point of view. Partly different approaches are needed depending on the fact that logistics is a company-intern background function or the core activity ("product") of a (logistics service provider) company. Another special issue is whether logistics controlling functions are applied to a certain company or to a group of different companies constituting a supply chain. Special attention will be paid to these considerations when establishing the basic models of identified cost and performance management tools designed for logistics decision support purposes.

2 Cost allocation models

A well operating cost management system is one of the basic tools of supporting logistics decisions because the optimal allocation of – mainly limited – resources requires sound information on costs of products or services. Furthermore, it is also important to elaborate the gross and net margins of these profit objects. Margins show the contribution of each product or service element to the total profit of the observed company.

However, current practices in logistics cost calculations often prefer using average values of aggregated costs, that is why indirect cost items are allocated to the different product or service units on an arbitrary basis. Ignoring cause and effect relationships during cost allocation can lead to distorted information. Profit as well as loss generators in the supply chain may not be identified properly, which makes the evaluation and (re)organisation of logistics processes less reliable.

A possible solution to the problems mentioned before can be the inclusion of technology principles into logistics cost calculation mechanisms. Thus cost allocation can be realised in a more exact way by taking into account cause and effect relations between activities within business processes. Of course the starting point of calculations are the – in general less detailed – cost and revenue data provided by the general ledger, however, these are combined with additional – possibly detailed – performance data describing the logic of technology processes.

The combination of accountancy and technology oriented information can be realised in – at least – two ways [2]:

1 based on cost objects or

2 based on activities.

The followings try to elaborate logistics cost allocation models by using both of these approaches.

2.1 Cost object based logistics cost calculation

The proposed scheme of cost object based logistics cost calculation is shown on Fig. 1 [1]. According to this model logistics costs are identified and then differentiated into direct and indirect items through the cost type calculation. Direct cost items are allocated to the profit objects (products/services) while the indirect ones go into the cost object calculation. Logistics performances (connected to given cost objects and measured in tonne kilometres, hours, pieces, etc.) are the other inputs for cost object calculation. The monetisation of performances (by using their specific costs) is carried out in the cost object module. The profit object calculation module has the task to elaborate the (logistics related) costs (= direct cost items + monetised logistics performances consumed by a given object) of products or logistics services. At last, by assigning revenue data to profit objects it will be possible to calculate their margins, too (if logistics is the core activity of the company).

Logistics performance calculation – as a preparatory phase – is essential from the point of view of controlling costs as it produces the basic input data for exact cost allocation. However, problems can be arising when defining logistics performances, mainly when logistics can be regarded as a background service function in a certain company specialised on trade or producing goods. It is often the case that planning and evaluation of logistics operations (inventory, material handling, etc.) is carried out within manufacturing processes: logistics related performances can hardly be separated from manufacturing performances.

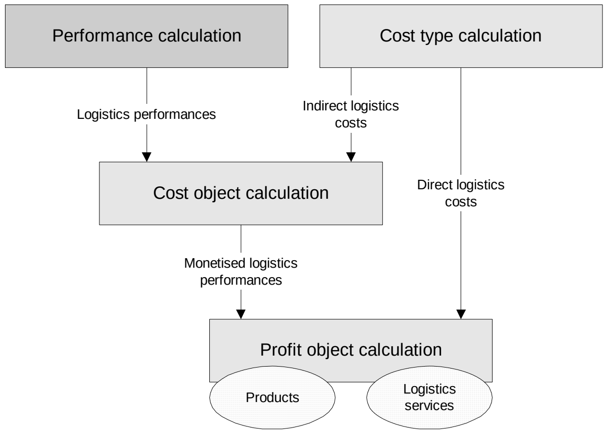

Fig. 1. The cost object based logistics cost allocation model

The identification problem of logistics performances is mainly company specific so only general principles can be defined to describe and systematise them [4]. At first it is advisable to distinguish between physical and dispositional elements. Within these broad categories performance type elements can be further differentiated depending on their nature. There are performance indicators related to making available certain goods/materials or information while others are in connection with movements. It is essential that the decomposition of performances and the definition of cost objects are harmonised. And at last exact measures (like tonne kilometre, handled piece, machine hour, etc.) shall be assigned to each performance type element.

The first – effective – phase of cost management is cost type calculation. Within this logistics related cost items are identified and systematised. The relevant cost items represent the monetised resource consumption of logistics procedures (inventory, warehousing, in-house and long distance transport, material handling, loading, etc.). These items can be obtained from the general ledger directly provided it has an adequate quality level of data gathering and processing. Otherwise custom-designed queries and additional cluster analyses need to be applied.

During the differentiation process the main task is to separate direct and indirect cost items. Direct cost items can be assigned to certain products or logistics services directly. What is classified as direct or indirect item is influenced mainly by the product or service definition of the examined company. The general experience is that manufacturing companies rarely have direct logistics costs – apart from outsourced activities. Logistics service companies on the other hand may – in principle – have a higher ratio of direct costs (because logistics is their core activity). However, as logistics services are getting more and more complex indirect operation costs may represent a considerable share in their case, too. Actually this fact – i.e. the considerable share of indirect costs – induces the introduction of cost object calculation as a controlling tool combining accounting and technology data.

Thus the second phase is cost object calculation. Its main tasks are to evaluate the cost efficiency (e.g. in the case of "make or buy" decisions) and elaborate the "intern" (theoretical) prices of logistics performances, furthermore to control logistics costs. Intern prices are essential from the point of view of cause-effect based cost allocation.

The first step of this phase is to define logistics cost objects producing logistics performances. These can be organisational units as well as pieces of equipment (e.g. warehouses) or machinery (e.g. vehicles). The performances of different objects can be obtained from the logistics performance calculation module while the cost items come from the cost type calculation module. These latter are the so called primary costs of a given cost object. Sometimes secondary cost items transferred from other cost objects (representing background services, for example maintenance) shall also be taken into account.

Cost items shall be differentiated into fixed and variable parts, too. Variable parts (like wages according to performance) are proportional to performance changes while fixed parts (usually depreciation) are independent from them. The intern (accounting) price of a logistics performance is calculated as the average (specific) variable cost of the corresponding cost object (measured in e.g. EUR/hours or EUR/tonne kilometre). If no differentiation between fixed and variable parts is possible total average costs can also be used as a second best solution. By using these intern prices logistics performances can be monetised.

Having intern prices and actual volumes of logistics performances the third (last) phase of the calculation process can be started. Its task is to transfer direct costs from the cost type calculation module to profit objects on the one hand and to allocate indirect costs (collected on cost objects) to profit objects according to consumed – and monetised – performances on the other hand. If average variable costs are used as intern prices for performances indirect fixed costs shall be included on aggregated levels of margin calculation only.

Two main forms of logistics profit object calculation can be distinguished depending on the definition of profit objects. If (manufactured) products are chosen as profit objects (when logistics is a background function) calculating logistics costs is a complementary tool to analysing operational efficiency. However, as logistics costs are often ignored or included into calculation procedures only on aggregated levels mainly with arbitrary allocation methods, the proposed model can contribute to make product cost calculation more reliable. When the profit objects are (complex) logistics services (logistics is the core activity in the company) all relevant costs and revenues are included in the calculation process so the profitability (margin) of outputs can be evaluated directly.

2.2 Activity based logistics cost calculation

The efficiency evaluation of logistics operations can be improved significantly by using the proposed calculation methods described before. However, it is important to note that the adopted methods have been (originally) optimised for the case of producing/manufacturing industries. As a consequence they (partly) ignore the process orientation of logistics. If more insight into logistics activities can be achieved it is worth improving the "traditional" cost calculation methods by using the principles of activity based costing (ABC). Thus not only cost and performance efficiency of logistics activities can be better evaluated but also complex processes are becoming more transparent. So activity based costing corresponds more to the specific features of logistics than cost object based calculations does.

The activity based cost calculation model adapted to logistics (see Fig. 2) technically further develops the "classic" cost object based approach [1]. The most important difference is that cost objects are replaced by activities. Performances as well as indirect costs are then first connected to activities and the allocation of indirect costs – based on cause-effect relationships – is carried out through monetised activity performances.

Otherwise the calculation mechanism is basically the same. The starting points are the logistics related costs differentiated into direct and indirect items. Direct costs are driven over to profit objects (products or logistics services) while indirect costs to logistics activities according to the actual level of resource consumption. It is a more favourable situation if the general ledger is able to distribute costs among activities directly (by using for example activity identification codes during recording transactions). Each activity shall be provided with a dedicated performance indicator (so called "cost driver"). Combining activity costs and cost drivers (result: average (specific) activity costs) makes it possible to evaluate (monetise) performances consumed by profit objects and thus to allocate indirect logistics costs to them exactly.

Consequently one useful function of ABC is to support the division of indirect logistics costs among products or services (outputs). This approach is similar to the cost object based calculation but here the costs and performances of logistics activities are in the foreground instead of the ones of organisational units or pieces of equipment. This method is suitable for analysing extensive supply chains (including several companies), too.

Another function of ABC is to monitor activities constituting hierarchical business processes from the point of view of cost efficiency, capacity utilisation and productivity. It is essential when business processes need to be reorganised (BPR) and the related decisions shall be established in an exact way. That is why logistics ABC can be regarded even as a strategic management tool [6].

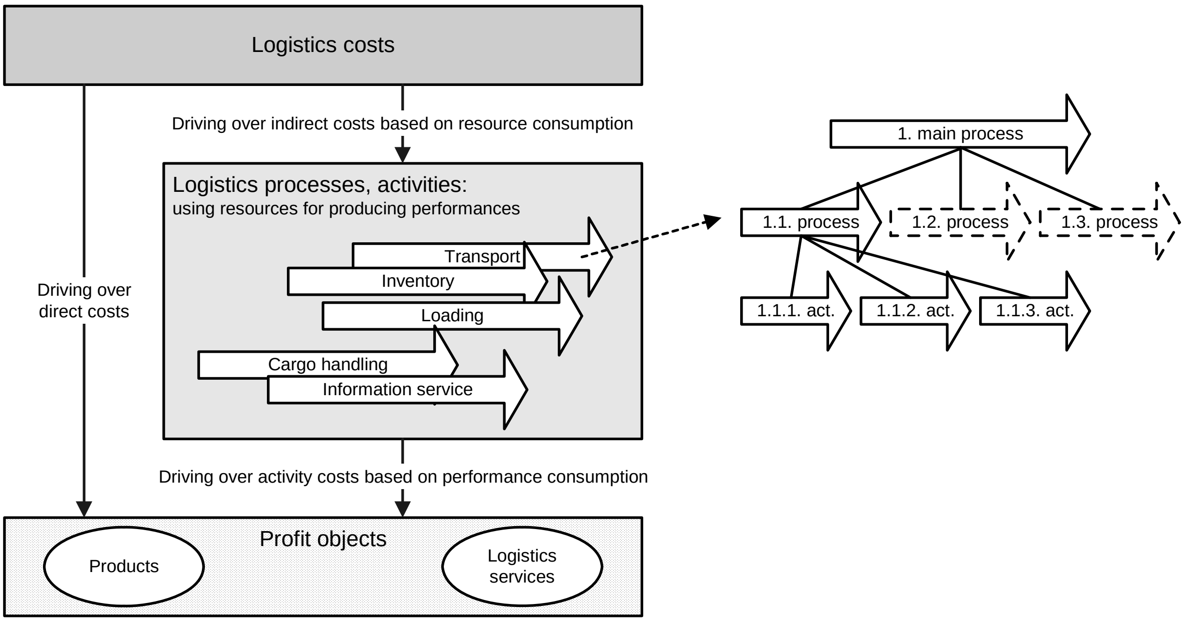

Fig. 2. The activity based logistics cost allocation model

3 Evaluation schemes

Logistics indices make it possible to evaluate logistics systems and processes in a simple way by concentrating the necessary information. This "diagnostic" function may be very helpful mainly in the case of ad-hoc decision making. Without indicators complex systems could hardly be supervised effectively. At the same time relying only on some indicators may distort the picture about operational efficiency [4].

Important practical experience is that indicators deliver the first signs only while finding out the cause and effect relationships behind them requires sound cost and performance management as outlined earlier.

It is advisable that the applied indices constitute a well defined structure by taking into account the relationships between them. Experiences show that this is often not the case in practice: the used indicators are selected on the basis of ad-hoc information demand and they are not harmonised with each other. The solution to these problems can be the elaboration of a logic framework which is able to systematise the logistics indicators by categorising them into different perspectives of business management. Another requirement is that interactions between indices are identifiable within the framework.

The Balanced Scorecard (BSC) method meets the requirements set before. The first component of the BSC model is the so called strategy map containing the main strategy goals and their fundamental relations. Fig. 3 shows the BSC strategy map adapted to logistics [1]. Two approaches shall be used because the content and the structure of BSC map are different depending on the role of logistics in the company (background function vs. core activity).

The "learning & development" perspective is the same in both cases. It identifies strategic directions on how to develop long term skills of the company (or logistics unit) by relying on human resource (HR) and innovation. Long term skills influence the operation of logistics related – business and technology – processes. Here the efficiency of relevant logistics activities is highlighted. The structure of "operation" perspective elements differs but the content is similar in the two cases. Logistics activities are structured according to their role in the organisation: control and physical processes for addressing company intern demand on background services; elements of the value chain for addressing market demand on complex services.

The task in "operation" perspective is to evaluate logistics processes and identify the most critical activities. What are these critical activities? Those elements of the value chain which are operated at high resource consumption or performance level, furthermore, where these two parameters are not in line with each other. Focusing interventions on critical activities during decision making results in better productivity. Activity based costing can be applied for finding out critical activities as it analyses costs (monetised resource consumption) and performances of logistics processes (as described before).

The remaining two perspectives show considerable differences. When logistics is a background function the "customers" and the "financials" perspectives are on the same hierarchical level of strategic goals. It means that satisfaction of intern clients (e.g. meeting quality standards when servicing manufacturing processes) is of the same importance as cost efficiency (e.g. reducing average costs of logistics activities within the company).

Nevertheless, when logistics is the core business area of the company the classic BSC strategic goal hierarchy prevails. Here operational efficiency is a prerequisite of reliable services and so of customer satisfaction. The latter results in growing revenues which is one of the preconditions of (sustainable) profitability – determined as the main strategic goal. Another prerequisite of profitability is cost efficiency which can be derived (also) from

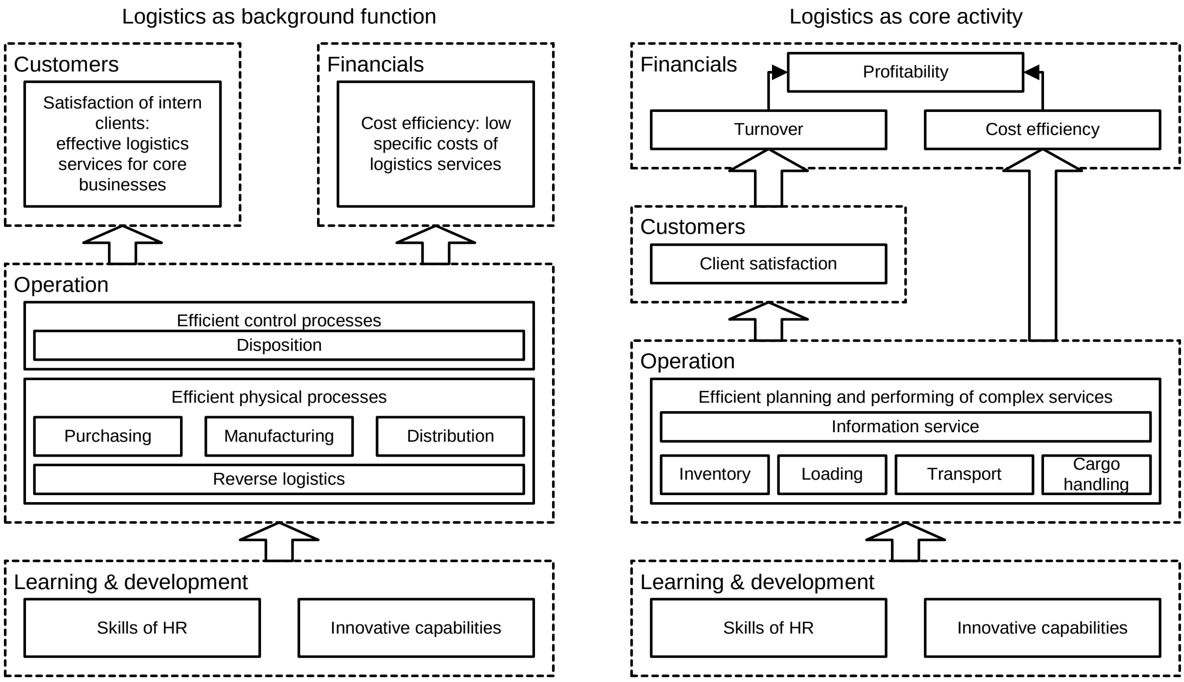

Fig. 3. The BSC model adapted to logistics

operational efficiency.

After having the strategy map compiled an adequate indicator system connected to systematised strategic goals has to be set up. Logistics BSC models can (usually) use the following options for indicators:

- financials:
  - profitability: profits, average profits, return on investments or on assets;
  - turnover: revenues and their growing rate, average revenues;
  - cost efficiency: costs, average costs, cost ratios;
- customers:
  - intern client satisfaction: meeting the requirements set by the intern service agreements;
  - customer satisfaction: number of orders and their growing rate, average revenue of a business contract, market share, number of complaints, number of (core) clients and the volume of their turnover, order processing time (flexibility);
- operation:
  - physical processes: availability of logistics services, capacity utilisation, speed of turn-round, logistics performances and their specific costs;
  - disposition processes: efficiency of process organisation, reliability of information flows;
- learning & development:
  - human resource: productivity of work, ratio of productive working hours, ratio of employees included into performance evaluation schemes, average training costs or time per employees;
  - innovation: ratio of working hours spent on innovative activities, volume or ratio of expenditures spent on innovation, number of implemented innovative logistics service elements or technology/organisational improvements, revenues arising from new services, cost reduction due to innovative operational solutions.

Indicators selected have to be measurable or at least estimations of your approximate values shall be made available. The classification of the above mentioned indices can not be regarded as determinate. Namely a given indicator can be connected to more strategic goals assigned to different perspectives (e.g. average revenue can be financial as well as productivity related index at the same time, etc.).

4 Supply chain controlling

The application of cost and performance management tools (mainly of ABC and BSC) makes it possible to extend controlling principles and procedures to complex supply chains integrating the service outputs of several logistics service providers. Fig. 4 indicates the main relationships of supply chain controlling [1].

Linking logistics ABC and BSC business models is reasonable even within a company. Doing so the operational perspective and its content (critical interventions) of BSC can be better established if outcomes of ABC methods examining logistics processes are available.

If extending the scope over the company ABC methods can be used properly as they examine processes instead of organisational units or equipment. The difference is that planning and performing logistics processes will be the tasks of more market actors having independent decision competencies. This case

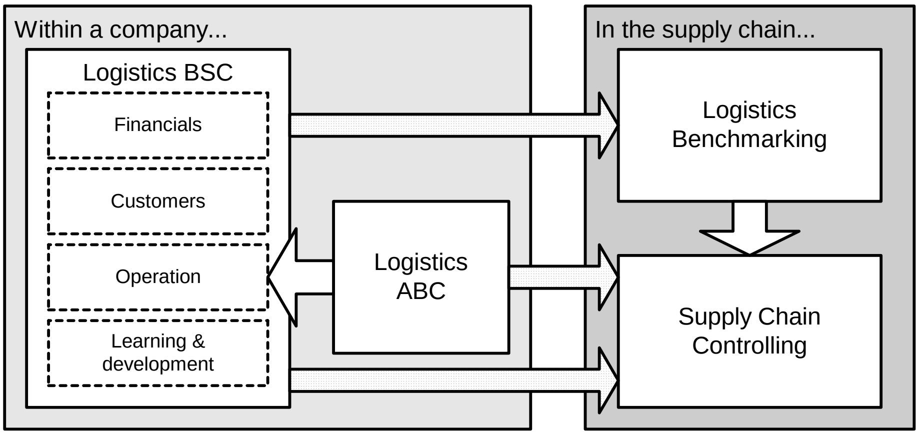

Fig. 4. Extending logistics controlling to the supply chain

(i.e. applying activity based costing in the whole supply chain) requires a certain level of standardisation in the field of data models, cost and performance definitions, accounting methods, etc. Otherwise it will not be possible to implement this integrated management tool and the corresponding management information system.

Also the BSC model can be made applicable in supply chain controlling as it ensures a widely accepted unified framework to decompose strategic business indicators. Of course, the selected indices are required to be standardised concerning their definition and calculation methods. Extending BSC to the whole supply chain makes it possible to conduct benchmarking by comparing actual index values of different companies. Naturally benchmarking does not prerequisite BSC, however, in case of adopting it benchmarking can be carried out on a more reliable basis.

Thus complex supply chain controlling systems covering all relevant logistics processes can be derived from extended BSC and ABC models. Their main features can be summarised as follows:

- make possible to analyse cost and performance efficiency of the entire supply chain so that its procedures can be planned and optimised in an exact way;
- support the harmonisation of resource and service planning between business partners;
- require standardised data models, compatible calculation methods and interoperable electronic information transfers, furthermore an intensive co-operation of interested partners based on mutual confidence.

5 Implementation issues

The practical implementation of identified controlling tools can be realised by developing and operating dedicated information systems. These decision support systems will be effective if they have appropriate information technology background with automated data collecting, processing and exploiting functions.

Developing and introducing of logistics controlling systems are – mainly – company specific tasks but some general considerations on these topics can be set. One of these considerations is that the expected functionality and quantitative/qualitative parameters of the controlling system are in line with the "logistics development level" of the given company. These development levels and the controlling tasks derived from them are summarised by Table 1 [7]. So it is advisable that the characteristics of management information systems in logistics shall be adapted to the different development phases.

If assessing market responses it can be stated that the use of logistics controlling methods is getting more and more widespread. This is due to the fact that logistics itself plays a more important role in business sectors. Furthermore, the interested market actors seem to accept that cost and performance management tools developed for the case of producing/manufacturing industries can be applied also in logistics, of course after a sound adaptation.

Nevertheless, dedicated logistics controlling information systems with full scale functionality can hardly be found. The following constraints preventing sophisticated logistics applications are often mentioned:

- difficult adaptability of general controlling and management methods to logistics;
- not sufficient accountancy and other transactional – input data producing – systems;
- not (enough) prepared users;
- not (enough) committed managers – because of growing accountability.

The practical application of logistics controlling is often explained by the need of enhancing accuracy and reliability of cost or profitability information. Beside this also the exact preparation of BPR decisions may induce developing effective logistics cost and performance management solutions. The general situation is that in the first phase of implementation a narrow scale pilot project concentrating on the main cost drivers and performance generators is launched. Decisions on the wider use are

Tab. 1. Connections between logistics development levels and controlling tasks

Logistics development levels	Controlling tasks
Phase #1: optimising physical material and goods flows, enhancing the efficiency of WTL[1] procedures	Supporting the operative planning and monitoring tasks of basic logistics activities (WTL) within the company
Phase #2: solving co-ordination problems connected to material and goods flows where optimisation concentrates on control procedures	Measuring the effects of logistics costs and performances: how they influence the flexibility, market position and financial situation of the company
Phase #3: process oriented organisation of logistics business activities and their enhancement to the whole company	
Phase #4: extending the process oriented logistics thinking and business practices to value/supply chains (transparency, compatibility, optimised allocation of resources)	Unified strategic planning and monitoring of complex business processes within supply chains

set after evaluating the first results: if the pilot project is successful the implementation towards a more sophisticated system will go on. The necessary level of sophistication is eventually influenced by the ratio of indirect costs of operation [5].

The Hungarian practice of logistics controlling is in the initial phase only. It means that (pilot) applications concentrate on performance management rather than on (detailed) cost calculation. Mainly inventory and warehousing are the logistics functions which have IT supported controlling information systems. These systems have the tasks to make material flows more transparent and to rationalise inventory and ordering processes. They use such methods as portfolio analysis of inventory, monitoring of material handling and optimisation of purchasing schemes.

The Hungarian pilot projects aiming to apply performance controlling in inventory, purchasing and warehousing have resulted in the following empirical outcomes [3]:

- decreasing average inventory level (10-40%);
- more accurate disposition based on reliable performance forecasts;
- higher capacity utilisation (even in manufacturing processes);
- increasing service level (20-40%);
- lower delivery time (5-20%);
- increasing customer satisfaction;
- decreasing administrative time and cost.

6 Concluding remarks

An actual challenge of modern operations management is to adapt cost and performance management (or controlling) principles and tools to logistics while the competency and range of logistics as company intern and extern business function is getting wider and wider.

According to the results of former and current researches it can be concluded that the application of controlling models and calculation procedures developed by management practice is – in general – possible for the case of logistics, too. However, it requires methodologies to be further developed or reshaped by taking into account the special management and technology features of logistics. Special attention is to be paid to accurate definition of logistics costs and performances, to different forming of models according to the role of logistics in the company (i.e. background or core function) and to process orientation which enables extending logistics controlling to the entire supply chain.

Practical experiences show that the implementation of controlling based decision supporting information systems in logistics has just started. Regarding implementation a stepwise approach can be suggested which takes into consideration the actual and planned range of logistics functions, competencies and activities, and furthermore the necessary/possible level of sophistication.

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